Stanford Project: RX--DERIVING KNOWLEDGE FROM TIME-ORIENTED CLINICAL DATABASES

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The objective of clinical database (DB) systems is to derive medical knowledge from the stored patient observations. However, the process of reliably deriving causal relationships has proven to be quite difficult because of the complexity of disease states and time relationships, strong sources of bias, and problems of missing and outlying data.

The goal of the RX Project is to explore the usefulness of knowledge-based computational techniques in solving this problem of accurate knowledge inference from non-randomized, non-protocol patient records. Central to RX is a knowledge base (KB) of medicine and statistics, organized as a taxonomic tree consisting of frames with attached data and procedures. The KB is used to retrieve time-intervals of interest from the DB and to assist with the statistical analysis. Derived knowledge is incorporated automatically into the KB. The American Rheumatism Association DB containing 7,000 patient records is used.

SOFTWARE AVAILABLE ON SUMEX

RX--(excluding the knowledge base and clinical database) consists of approximately 200 INTERLISP functions. The following groups of functions may be of interest apart from the RX environment:

SPSS Interface Package: Functions which create SPSS source decks and read SPSS listings from within INTERLISP.
Statistical Tests in INTERLISP: Translations of the Piezer-Pratt approximations for the T,F, and Chi-square tests into LISP.
Time-Oriented Data Base and Graphics Package: Autonomous package for maintaining a time-oriented database and displaying labelled time-intervals.

REFERENCES

Blum, R.L. and Wiederhold, G.: Inferring knowledge from clinical data banks utilizing techniques from artificial intelligence. Proc. Second Annual Symposium Computer Applications in Medical Care, IEEE, Washington, D.C., November, 1978, pp. 303-307.

Blum, R.L.: Automating the study of clinical hypotheses on a time-oriented database: The RX project. Submitted to MEDINFO80, Third World Conference on Medical Informatics, Tokyo, 1980.

Weyl, S., Fries, J., Wiederhold, G. and Germano, F.: A modular self-describing clinical databank system. Comp. and Biomed. Res. 8(3):279-293, June, 1975.

Wiederhold, G., Fries, J.F.: Structured organization of clinical data bases. AFIPS Conference Proc. 44:479-485, 1975.

Appendix D

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The following are the membership lists of the various SUMEX-AIM management committees at the present time:

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References

1. Feigenbaum, E.A., The Art of Artificial Intelligence: Themes and Case Studies of Knowledge Engineering, Proceedings of the 1978 National Computer Conference, AFIPS Press, (1978).

2. Nilsson, N.J., Principles of Artificial Intelligence, Tioga Publishing Company, Palo Alto, California (1980).

3. Winston, P.H., Artificial Intelligence, Addison-Wesley Publishing Co., (1977).

4. Nilsson, N.J., Artificial Intelligence, Information Processing 74, North-Holland Pub. Co. (1975).

5. Barr, A., Cohen, P., and Feigenbaum, E.A. (Eds.), The Handbook of Artificial Intelligence Volumes I, II, and III William Kaufmann, Inc. Los Altos, Calif. (1981 and 1982)

6. Boden, M., Artificial Intelligence and Natural Man, Basic Books, New York, (1977).

7. McCorduck, P., Machines Who Think, W.H. Freeman and Co., San Francisco (1979).

8. Coulter, C. L., Research Instrument Sharing, Science, Vol. 201, No. 4354, August 4, 1978.

9. Metcalfe, R.M. and Boggs, D.R., Ethernet: Distributed Packet Switching for Local Computer Networks, Comm. ACM, Vol. 19, No. 7 (July 1976).

10. Shoch, J.F. and Hupp, J.A., Performance of an Ethernet Local Network -- A Preliminary Report, Proceedings of the Local Area Communications Network Symposium, Boston,May 1979.

11. Taft, E.A., Implementation of PUP in TENEX, Internal XEROX PARC memorandum, June 1978.

12. Boggs, D.R., Shoch, J.F., Taft, E.A., and Metcalfe, R.M., PUP: An Internetwork Architecture, XEROX PARC report CSL-79-10, July 1979.

13. Digital Equip. Corp., Intel Corp., and Xerox Corp., The Ethernet - Data Link and Physical Layer Specifications, Version 1.0, September 30, 1980.